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LARGE AREA CROP INVENTORY EXPERIMENT (LACIE)



NASA NOAA USDA

Level III Baseline

**INFORMATION STORAGE, RETRIEVAL,
 AND REFORMATTING SUBSYSTEM
 (ISRRS) REQUIREMENTS**

NOTICE: THIS IS A BASELINED LEVEL III DOCUMENT CON-
 TROLLED BY THE LACIE LEVEL III CHANGE CONTROL BOARD.
 ANY PROPOSED CHANGES SHOULD BE DOCUMENTED ON AN
 RECP FORM AND TRANSMITTED TO R. B. MACDONALD,
 LACIE MANAGER, NASA-JSC, CODE TF, HOUSTON, TEXAS 77058.

**National Aeronautics and Space Administration
 LYNDON B. JOHNSON SPACE CENTER**

Houston, Texas

November, 1975

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(E79-10113) LARGE AREA CROP INVENTORY
 EXPERIMENT (LACIE). LEVEL 3 BASELINE;
 INFORMATION STORAGE, RETRIEVAL, AND
 REFORMATTING SUBSYSTEM (ISRRS) REQUIREMENTS,
 VOLUME 5, REVISION A (NASA) 65 P HC A04/MF



REVISIONS

REV LTR	CHANGE NO.	DESCRIPTION	DATE
A	5M0046	BASELINE ISSUE (Reference CCBD #III-0001, dtd December 16, 1974)*	12-16-74
		MAJOR REVISION DUE TO RESCOPE EFFORT	11-4-75
		*The changes required by the following RID's which were approved during the LACIE Project Review conducted December 3 through 5, 1974, have been incorporated into this baseline issue of the LACIE Level III Requirements Documents: 0-2 through 0-13, 0-15 through 0-29, and 0-31 through 0-46 1a-1, 1a-2, 1a-10, 1a-21, 1a-34, and 1a-36 1b-3 and 1b-6 1c-2, 1c-4, 1c-5, 1c-9, 1c-10, 1c-13, 1c-16, 1c-17, and 1c-20 2-12a, 2-13, 2-17, and 2-27 All other changes required by the remaining RID's approved during the Project Review will be incorporated by transmitting an RECP to the LACIE Level III Change Control Board for approval. Each RECP should be accompanied by the appropriate RID Closeout Form as described during the Project Review.	

LIST OF EFFECTIVE PAGES

The current status of all pages in this document is as shown below:

<u>Page No.</u>	<u>LACIE Change Date</u>	<u>Authorizing CCBD No.</u>
<u>ii</u>	Revision A, 11/4/75	5M0046
<u>iii</u>	7/21/77	7M0025
<u>iv</u> through <u>vi</u>	Revision A, 11/4/75	5M0046
<u>1-1</u>	Revision A, 11/4/75	5M0046
<u>1-2</u>	9/22/76	6M0037
<u>1-3</u> through <u>4-8</u>	Revision A, 11/4/75	5M0046
<u>4-9</u>	7/21/77	7M0025
<u>4-10</u> through <u>4-14</u>	Revision A, 11/4/75	5M0046
<u>4-15</u> through <u>6-6</u>	9/22/76	6M0037
<u>7-1</u> through <u>11-1</u>	Revision A, 11/4/75	5M0046

FOREWARD

Efficient management of the Large Area Crop Inventory Experiment (LACIE) dictates that effective controls of project activities be established. To provide a basis for effective control, documentation will be prepared, baselines set and subsequently controlled by the proper management levels.

The specific control documents which will be used are defined in the LACIE Project Plan, LACIE-C00605. All elements of the LACIE Project must adhere to these baselined control documents and where it is considered that the requirements should be changed, the proper change request accompanied by a full justification must be submitted to the proper management level in accordance with established procedures. These documents will be maintained current by change notices and revisions as required. Each change notice and/or revision will reference the applicable Change Control Board Directive (CCBD) which approved the change.

This document, LACIE-C00200, Volume V (Rev. A), defines the Information Storage, Retrieval, and Reformatting Subsystem Requirements and has been prepared in accordance with "Instructions for Preparation of LACIE Requirements", LACIE-00100, Revision C, dated November 20, 1974. "Full-Up System" as used in this document is defined as the system required to accomplish LACIE Phase 2. In general, the approach used in each section is to first specify the requirements of the "Full-Up System" and then to specify the requirements of any interim systems by reference to specific paragraphs in the "Full-Up System" requirements sections of the document. The LACIE Project phases are defined in the LACIE Project Plan, LACIE-C00605.

The organization responsible for the implementation of each requirement defined in this document is specified on an individual requirement basis. Where the implementation responsibility applies to the complete section, the implementation responsibility is specified after the section title. A "section" for the purposes of designating implementation responsibility is defined as being any numbered paragraph and all subparagraphs. Where different implementation responsibilities apply to different portions of a section, the implementation responsibility is specified on an individual paragraph or sentence basis, as applicable. All implementing organizations designated shall accomplish their implementation activities in accordance with the requirements specified herein.

R. B. MacDonald

for R. B. MacDonald
Manager, Large Area Crop Inventory Experiment

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GLOSSARY

ADP	Automatic Data Processing
AI	Analyst Interpreter
ASVB	Applications System Verification Branch
B/W	Black and White
CAMS	Classification and Mensuration Subsystem
CAS	Crop Assessment Subsystem
CCBD	Change Control Board Directive
COD	Center Operations Directorate
CPU	Central Processing Unit
DAPTS	Data Acquisition, Preprocessing and Transmission Subsystem
DAS	Data Analysis System
DCS	Data Collection Station
D-H-M-S	Days-Hours-Minutes-Seconds
DPR	Data Processing Request
DSAD	Data Systems and Analysis Directorate
EDUI	Electronic Data User Interface
EOD	Earth Observations Division
FSO	Facilities Support Office
Full-Up System	Subsystem requirements to accomplish LACIE, Phase II
ICD	Interface Control Document
ID	Identification
IES	Information Evaluation Subsystem
Interim Systems	Subsystem requirements to accomplish sub- phases of LACIE Phase I, excluding sub- phases IA and IB
I/O	Input/Output
ISRRS	Information Storage, Retrieval, Refor- mating Subsystem
ITS	Intensive Test Site
JSC	Lyndon B. Johnson Space Center
LACIE	Large Area Crop Inventory Experiment
LACIE PO	LACIE Project Office
Landsat	Land Satellite (formerly Earth Resources Technology Satellite)
LPDL	LACIE Physical Data Library (part of FSO)
MSS	Multispectral Scanner
MTBF	
MTTR	
NASA	National Aeronautics and Space Administration
NASA-DSAD	NASA, Johnson Space Center, Data Systems and Analysis Directorate
NASA-GSFC	Goddard Space Flight Center
NOAA	National Oceanic and Atmospheric Administration
PDL	Physical Data Library

PDUI	Physical Data User Interface
PFC	Production Film Converter
PPS	Probability proportional to size
PTL	Photographic Technology Laboratory
PCAF	Royal Canadian Air Force
RTEB	Research, Test, and Evaluation Branch
SSAD	Science and Applications Directorate
SPE	System Performance Evaluation
S/S	Subsystem
TBD	To Be Determined
USDA	United States Department of Agriculture
USEP	Universal Screening and Editing Program
WMO	World Meteorological Organization
YES	Yield Estimate Subsystem
Y/M/D	Year-month-day

SECTION 1.0
FUNCTIONAL RESPONSIBILITIES

1.1

GENERAL

The Information Storage, Retrieval, and Reformatting Subsystem (ISRRS) will support each of the other subsystems serving as the integrating system for all data received and processed. This capability will be achieved by maintaining both an electronic and a physical data base and by coordinating all custom processing. The custom processing function will include the responsibility for imagery generation and production keypunch operations.

The functional responsibilities of the ISRRS include the following:

- A. Storage and retrieval of all electronic data as required by each subsystem
- B. Storage and retrieval of all nonelectronic data required by each subsystem
- C. Insure the execution of all "custom" data preparation functions necessary to transform raw input data into the formats required to meet the preceding requirements

1.2

SPECIFIC

There will be two basic interface controls within the ISRRS subsystem: the Physical Data User Interface (PDUI) and the Electronic Data User Interface (EDUI). The following are the functions required by the ISRRS for each of these interfaces.

1.2.1

Physical Data User Interface

The PDUI will receive all data to be stored in the ISRRS from the Data Acquisition Preprocessing and Transmission Subsystem (DAPTS). Those data which are nonelectronic will be stored in the LACIE Physical Data Library (LPDL). Those data which are electronic, i.e., tapes and punched cards will be processed, then stored as follows: (1) GSFC tapes and copies in the tape library which is an adjunct of the EDUI; (2) status and tracking, and other interim tapes necessary to support the electronic data base operations will be stored; (3) tapes and/or punched cards

from NOAA will be stored in the LPDL; and (4) results tapes from CAMS and CAS will be stored in the LPDL. When film processing is required, the PDUI will insure that all necessary data are forwarded to the Production Film Converter (PFC) and that the processed imagery data are cataloged and stored in the LPDL. The PDUI will be responsible for maintaining the data archives (physical and electronic). The PDUI will be responsible for forwarding all electronic data to the EDUI.

1.2.1.1

DAPTS/YES interface.-- All field and historical agricultural data will be processed through the DAPTS subsystem. All meteorological data will be processed through the YES subsystem. This data will be received, logged and categorized by the PDUI.

1.2.1.2

Physical library.-- All nonelectronic data received will be logged and stored in the LPDL. This library will perform the following functions:

- A. Storage and retrieval of physical (nonelectronic) data
- B. Library maintenance
- C. Maintenance of a directory of all library data
- D. Maintenance of the data acquisition data base
- E. Purge control of old/unnecessary nonelectronic data
- F. Provide access security for the library
- G. Track status of all physical data
- H. Monitor speed and accuracy of library function

1.2.1.3

Production film converter.-- The PDUI will insure that all required data for custom film processing are transmitted to the PFC for conversion. The PFC operation will perform the following functions:

- A. Log all film processing requests into and out of the system
- B. Generate imagery data as required

1.2.1.4

Archive.-- The PDUI will coordinate all data to be released to the archive operation by the physical or electronic library. The archive

operation will be responsible for the following:

- A. Archive copies of all documents deemed necessary for reconstructing the history of LACIE
- B. Maintain directory of all data archived
- C. Provide access security for data archived
- D. Coordinate data archived to insure that duplication of archive data does not occur

1.2.1.5

Tape duplications.- The PDUI will be responsible for coordinating and accounting for the duplication of tapes.

1.2.2

Electronic Data User Interface

The PDUI will coordinate with the EDUI on all incoming electronic data. The EDUI will receive all electronic raw data from the PDUI. The EDUI will access the processor, tape library, data base manager, and/or the data base as required.

The EDUI will be responsible for the following:

- A. Maintain a directory of electronic data
- B. Purge control of old/unnecessary data
- C. Track status of all electronic data
- D. Control of the tape library

1.2.2.1

Processor.- The processor will be responsible for the following:

- A. Data processing required by the ISRRS
- B. Tracking the performance of the ISRRS subsystem
- C. Monitoring the usage of electronic data for scheduling

1.2.2.2

Data base manager.- The data base manager will control all access to and from the data base. The following are functions of the data base manager:

- A. Control of storage and retrieval of data in mass data storage
- B. Data base quality testing
- C. Mass storage purge control
- D. Fail-safe and checkpoint operations
- E. Data base integrity

1.2.2.3 Data base.- The electronic data base will be stored in mass storage and on tape. The data base covered in this section refers to that data located in mass storage. The following function will be performed by the data base: store and retrieve all electronic data required by each subsystem.

1.2.2.4 Tape library.- Electronic data considered active, but not required to be maintained in the mass storage data base, will be maintained in the tape library. The following functions will be performed by the tape library:

- A. Storage and retrieval of electronic data maintained on tape
- B. Maintenance of a content directory of all tapes stored
- C. Storage of all GSFC data tapes received
- D. Provision of access security for all tapes
- E. Provision of purge control of old/unnecessary data

1.2.3 Applicable Dates
Throughout this document, category 1 requirements are those which are defined and will be effective from the beginning of Phase II. Category 2 requirements require some additional refinement but will also be effective at the beginning of Phase II. Category 3 requirements are less defined and have no set delivery date.

SECTION 2.0
APPLICABLE DOCUMENTS

No reference documents have been identified as applicable to these requirements.

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SECTION 3.0
FUNCTIONAL FLOW DIAGRAMS

3.1

ISRRS DEVELOPMENT

The ISRRS development milestones are presented in figure 3.1-1. Following the definition of preliminary requirements and detailed requirements, the PFC and three sequential phases of computer implementation will be completed.

To implement a milestone, the sequence of events is presented in figure 3.1-2. This flow applies to the PFC, each computer phase, and the terminal access to data base. Upon completion of the requirements, hardware and software will be developed separately until each has been tested. They will then be combined and tested as a system.

3.2

ISRRS OPERATION

The functional diagrams are illustrated in figures 3.2-1 through 3.2-4. Figure 3.2-1 is an overview of the total ISRRS, and each of the major ISRRS functions are addressed individually in the remaining figures.

3.2.1

Interim Systems

Requirements for interim systems are TBD.

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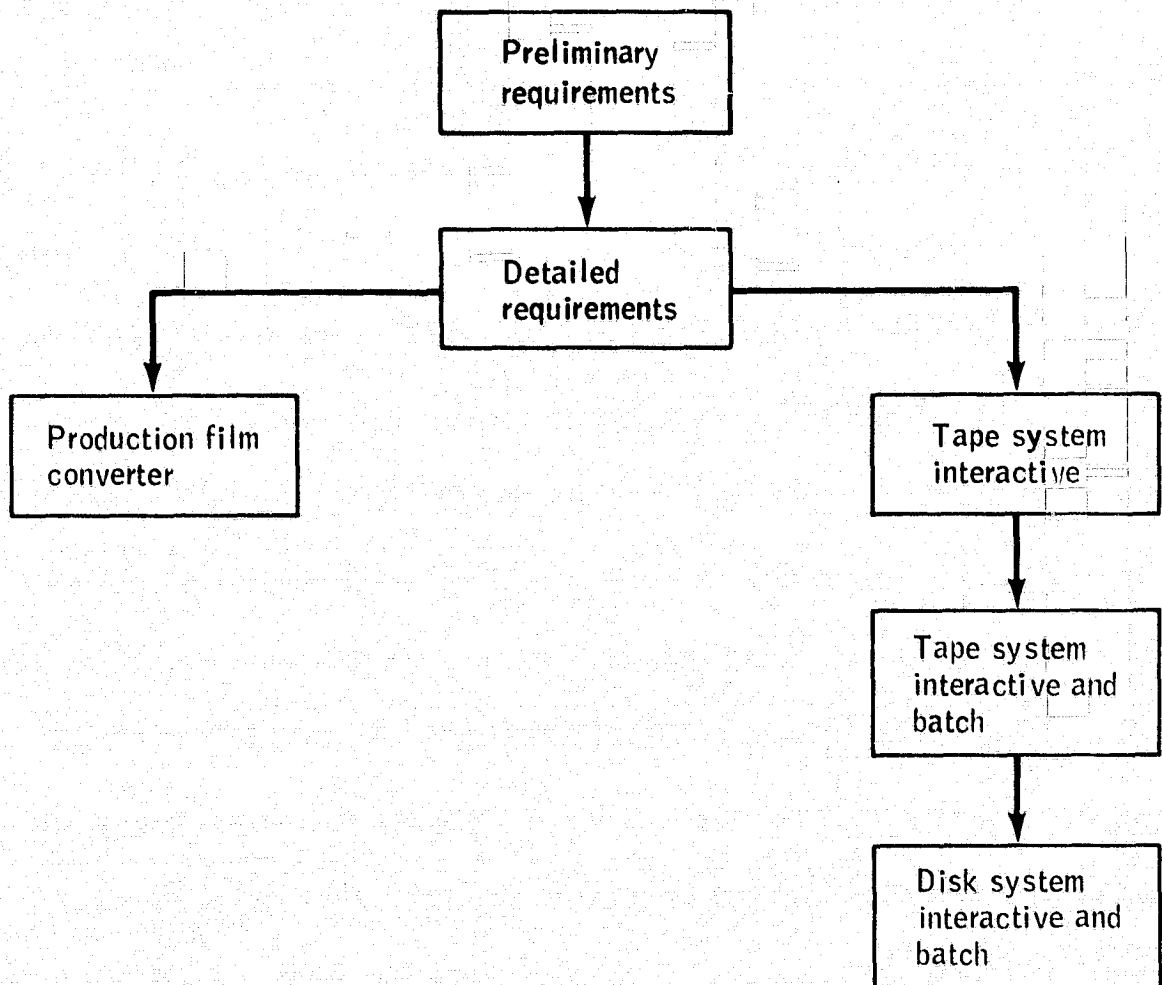


Figure 3.1-1.- ISRRS development milestones.

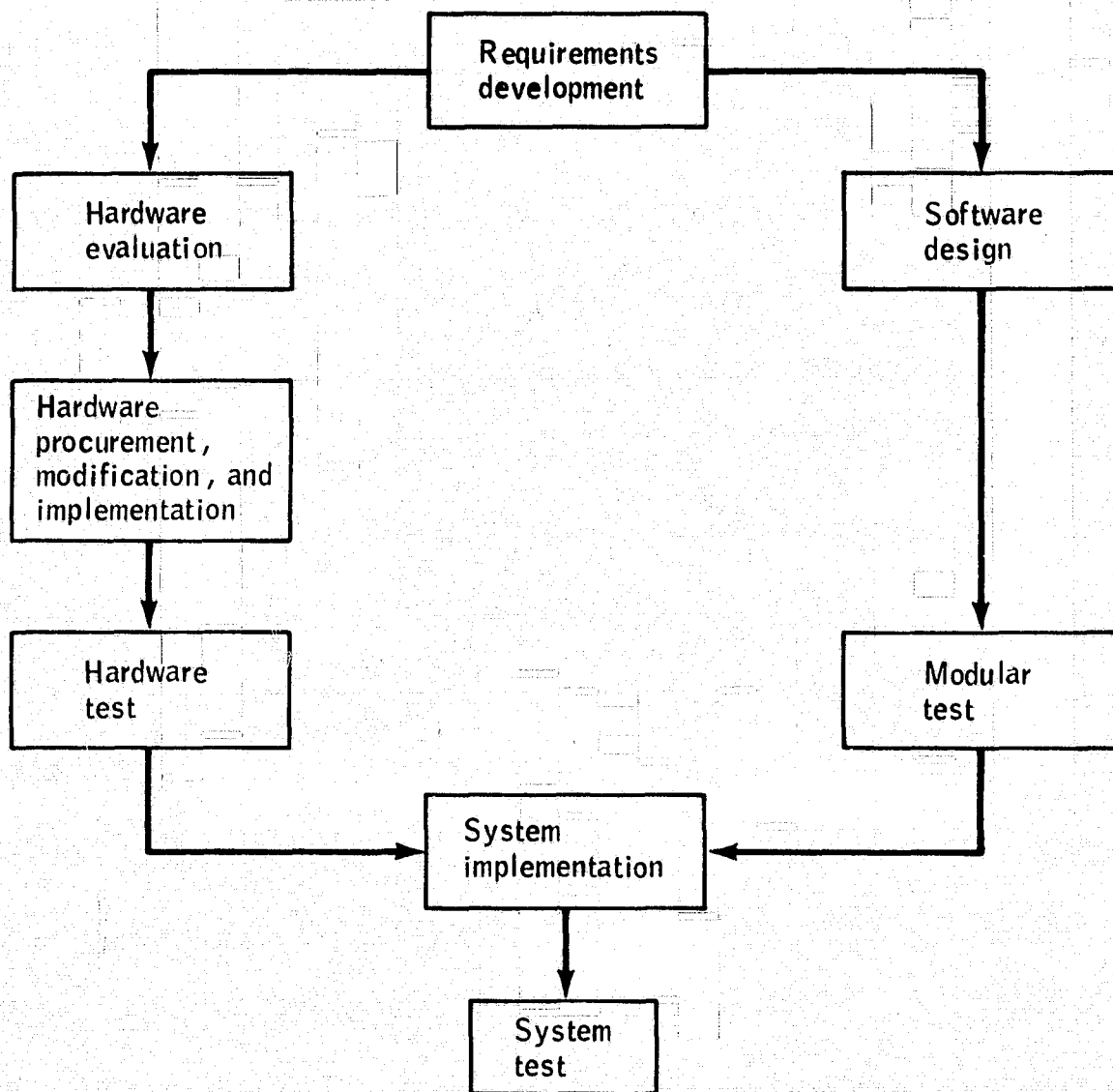


Figure 3.1-2.- Milestone implementation flow.

3-4

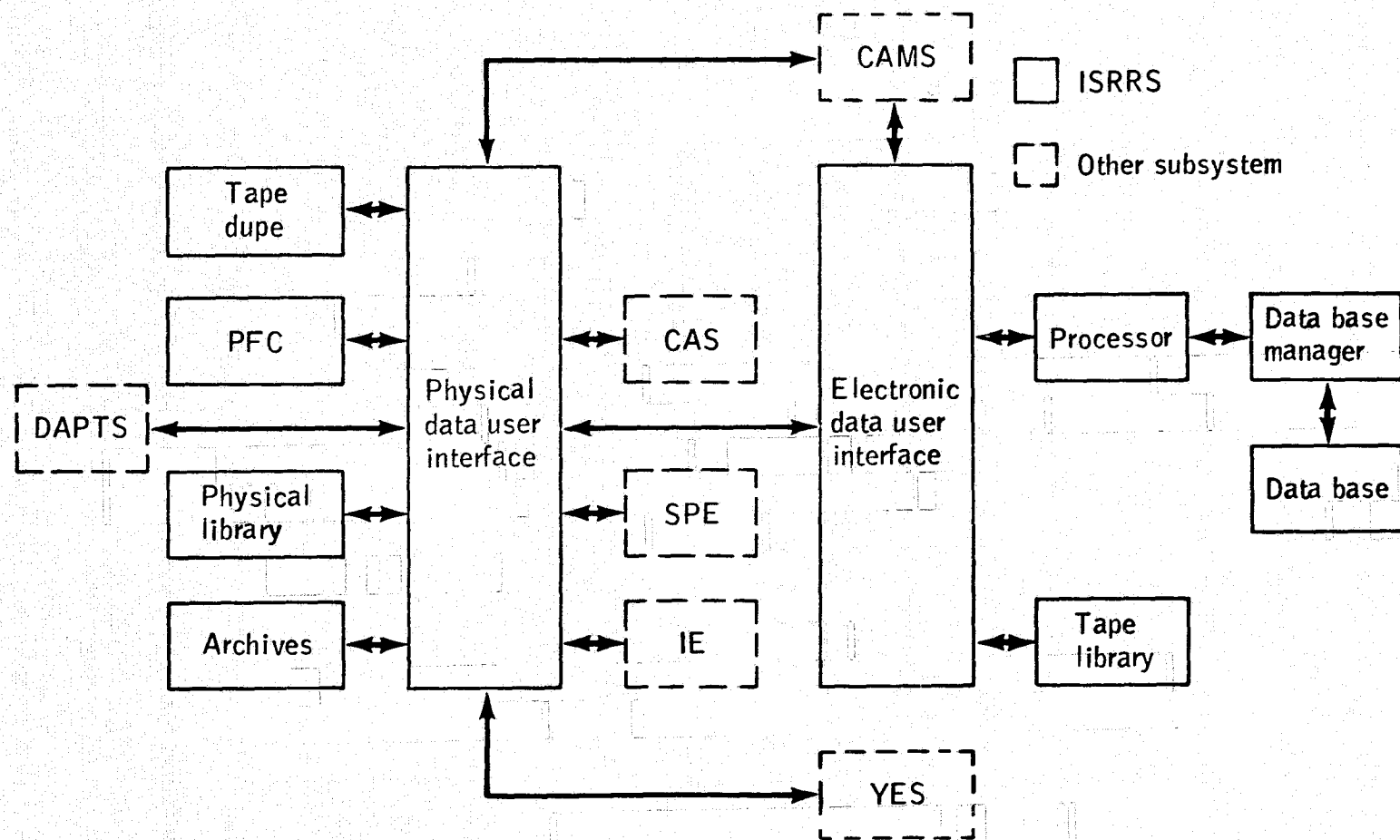


Figure 3.2-1.- ISRRS functional block diagram.

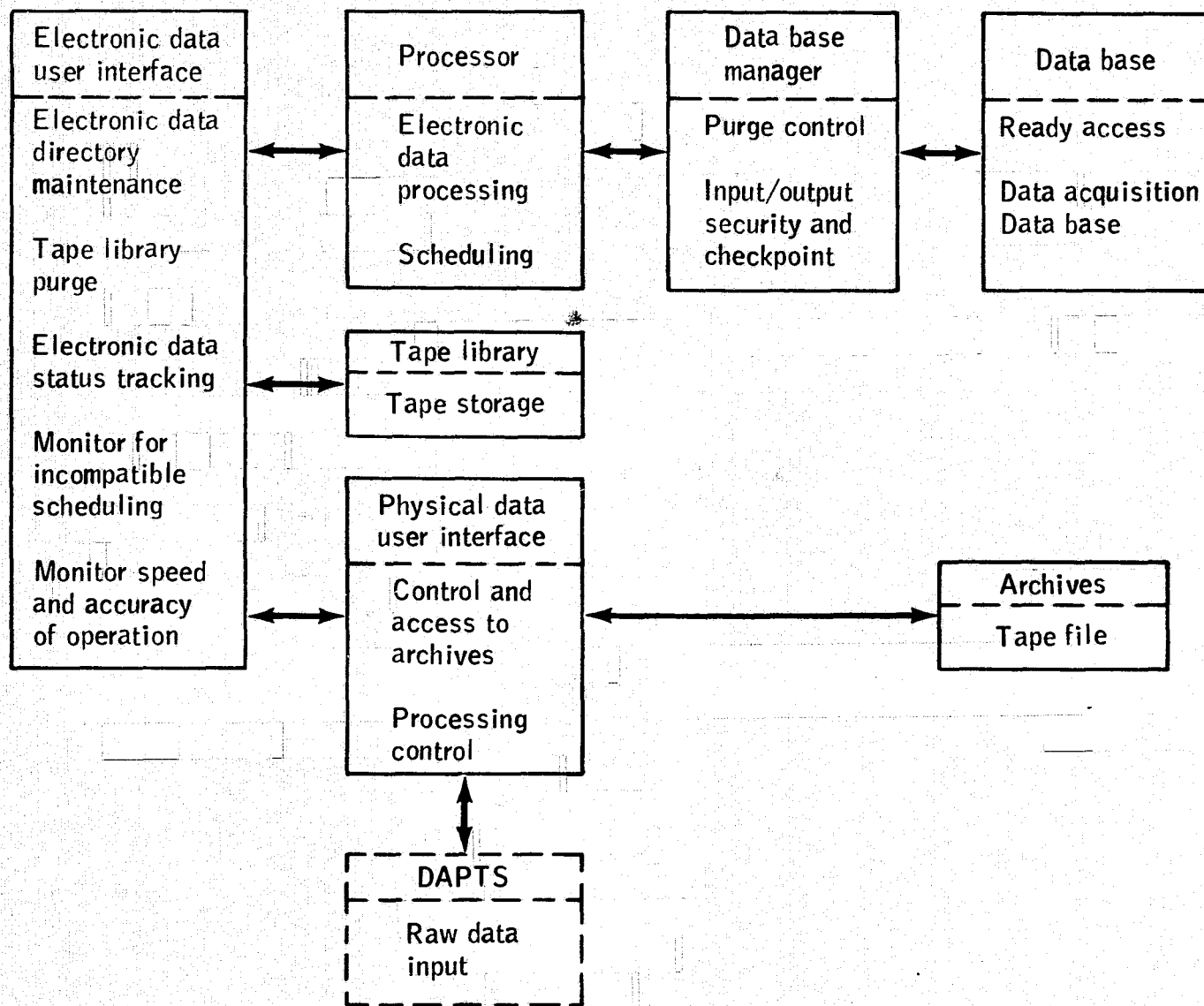


Figure 3.2-2.- Functional diagram of electronic storage/retrieval.

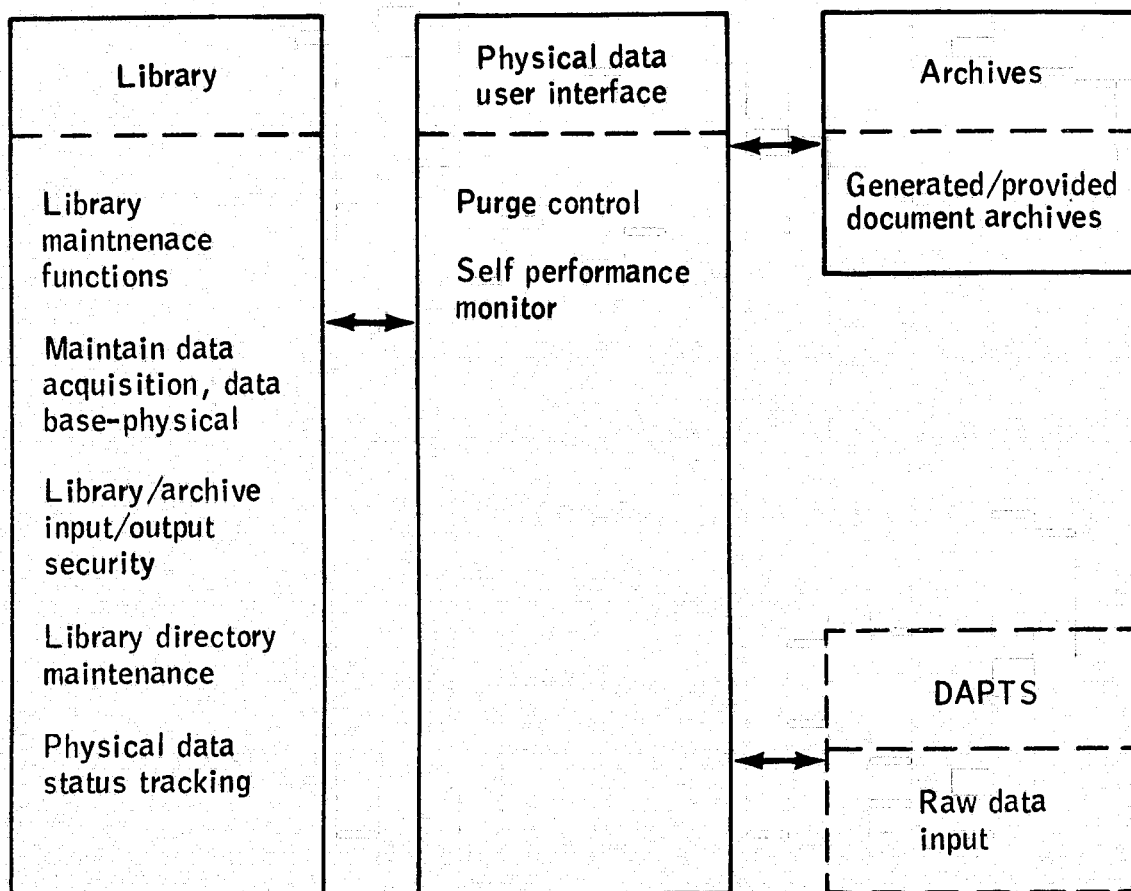


Figure 3.2-3.- Functional diagram of physical storage/retrieval.

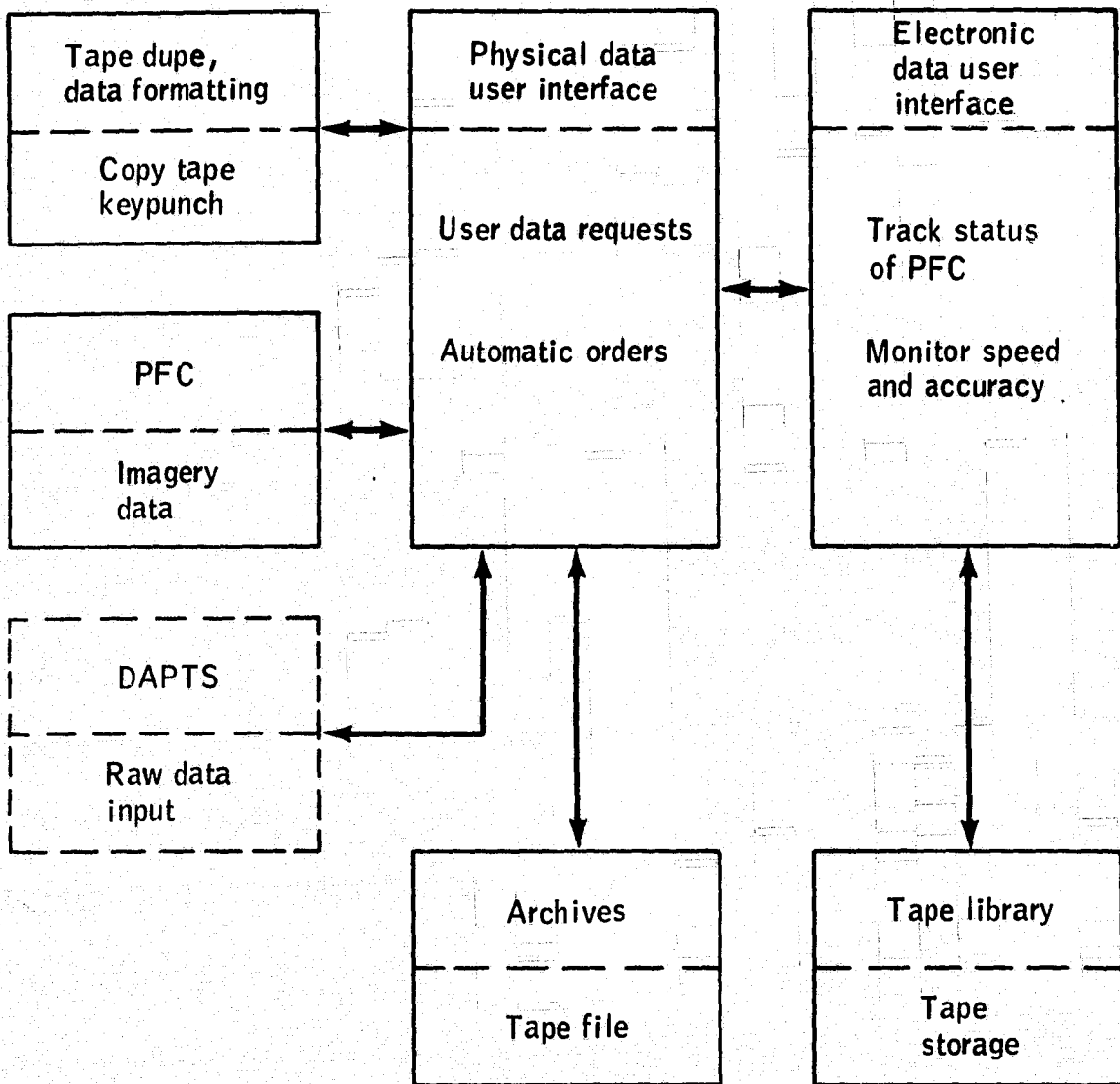


Figure 3.2-4.- Functional diagram of custom data preparation.

SECTION 4.0
SUBSYSTEM REQUIREMENTS (CONSOLIDATED)

4.1 PHYSICAL DATA USER INTERFACE

The Physical Data User Interface (PDUI) function will be provided by NASA-DSAD (for electronic data, e.g., GSFC tape data and data operations) and by the LPDL for nonelectronic data, e.g., documents, maps, film imagery, NOAA data cards, etc. The interface between the two will consist of the flow of reformatted data, requests for reformatting, and any other functions linking the Electronic Data User Interface (EDUI) to all other LACIE operations.

4.1.1 DAPTS Interface

All nonderived data to be utilized in the ISRRS will be received from the DAPTS subsystem. The following are the data to be received.

4.1.1.1 Landsat MSS. - Following the NASA-GSFC data preprocessing operations, Landsat MSS computer tapes will be prepared for transmittal to NASA-DSAD. Additionally, processing information will be transmitted concerning whether or not a segment has been acquired, if an order still exists for acquisition/processing in the NASA-GSFC data base, reasons for data rejection (if rejected), and whether or not processing has been completed. (Required by CAMS, CAS; Category 1; implemented by NASA-DSAD)

The electronic PDUI will catalog and index the incoming data, perform quality checks on the data to assure that the data tape is readable and contains no parity errors, and perform tape copy operations to provide redundant data sources. Unreadable tapes will be reordered from GSFC. Generation of imagery products to aid data analysis will also be accomplished. (Required by CAMS; Category 1; implemented by NASA-DSAD.) Any data reformatting necessary for interface with other subsystems will also be accomplished within this subsystem. Landsat data from the same sample segment will require composition onto tape to form multi-channel (up

to 64) temporal data sets. These data will be used in imagery generation and may be utilized as a partial data base. (Required by CAMS; Category 1; implemented by NASA-DSAD)

Subsystem output shall consist of imagery products required for utilization by the analyst interpreter (AI). Temporally composed tapes of sample segments will be output both for imagery generation purposes and for possible utilization as part of the data base. Four channel tapes from this subsystem (NASA-GSFC tape copies) will be utilized for PFC imagery generation. (Required by CAMS; Category 1; implemented by NASA-DSAD)

Both data tape and card updates to the NASA-GSFC acquisition/processing data base will be output by the electronic PDUU. Data tape reorders for quality rejection reasons will be output to the GSFC preprocessing section of the DAPTS. (Required by DAPTS; Category 1; implemented by NASA-DSAD.)

NASA-GSFC data base status information from the preprocessing subsystem and JSC daily reports of received data should be utilized automatically by the Classification and Mensuration Subsystem (CAMS) in determining processing scheduling and should also be utilized to determine the necessity of designating new training segments. (Required by CAMS; Category 1; implemented by NASA-DSAD)

4.1.1.2

Field data.- Field data will be input to the data base from two sources. One is an internally generated input in that the Landsat imagery generated in the ISRRS will be utilized to identify training and test field coordinates from any sample segments that are designated as training segments. Additionally, the ADP analysts may interactively specify field coordinates for designated wheat, designated other, and designated undefined fields for utilization by the CAMS. Field boundaries will be entered to the data base by specifying line-pixel coordinates of field apices. Nominally, field data on punched cards will be received by

the nonelectronic PDUI for transmittal to the electronic PDUI. There, these data will be stored in the ISRRS electronic data base and utilized by the CAMS for generating statistics and classifying data. (Required by CAMS; Category 1; implemented by NASA-DSAD/NASA-S&AD-FSO)

4.1.1.3

Meteorological data.- Meteorological surface station data from the NOAA will be formatted on computer compatible tape. The original tape will be stored in the LPDL. (Required by NASA-S&AD-RT&E; Category 1; implemented by NASA-S&AD-FSO)

Yield strata measurement data generated by YES will be stored in the LPDL. (Required by CAS; Category 2; implemented by NASA-S&AD-FSO)

4.1.1.4

Historical data.- Weekly meteorological summaries and biweekly crop calendar adjustments will be input to the LPDL. Additionally it is estimated that other historical information such as wheat acreage and production for the United States should be an input to this subsystem. These data will be received by the nonelectronic PDUI and stored in the physical library. (Required by CAMS, CAS, DAPTS; Category 1; implemented by YES, NASA-S&AD-FSO)

4.1.2

Physical Library (Physical Storage/Retrieval)
Certain parts of the data base will be provided in document form. These may be supplied on a one-time basis or on a regular time schedule. The one-time-only data will include but not be limited to Landsat data definition, historical meteorological data, and historical production data. (Required by all subsystems; Category 2; implemented by NASA-S&AD-FSO)

The regularly issued data will include, but not be limited to the following:

- A. SPE status reports (monthly cycle)
(Required by all subsystems, Category 3; implemented by NASA-S&AD-FSO)
- B. Catalogs of aircraft data from intensive sites with a comprehensive index generated by Project Support Office (18-day cycle)

- (Required by CAMS, CAS; Category 2; implemented by NASA-S&AD-FSO)
- C. Reference catalog of field data (ground truth) generated by Project Support Office (18-day cycle) (Required by CAMS, CAS, ISRRS; Category 3; implemented by NASA-S&AD-FSO)
- D. Landsat data acquisition at NASA-DSAD (daily within 8 hours of receipt) (Required by ISRRS; Category 1, implemented by NASA-DSAD) Transmittal of NASA-DSAD acquisition reports will be accomplished by NASA-S&AD-FSO (daily within 8 hours of report receipt). (Required by CAMS; Category 1; implemented by NASA-S&AD-FSO)
- E. Update of reference documentation by NASA-S&AD-LACIE-PO (Required by ISRRS; Category 3; implemented by NASA-S&AD-FSO)

4.1.3

Production Film Converter (PFC)

(Required by CAMS; Category 1; implemented by NASA-DSAD) The PFC will be utilized to generate various imagery products required to support LACIE. Two broad categories of imagery products will be generated, those generated directly from individual Landsat data sample segments or composed data tapes, and those generated from data derived from raw imagery. The latter includes such products as clustering maps and training field overlays. Control of PFC operations will be the responsibility of the electronic PDUI.

4.1.3.1

Imagery processing

- A. Selection of data for display
 - 1. Color and black and white imagery products generated on the PFC from Landsat imagery should be produced on 5-inch film. Imagery products will be required daily from NASA-GSFC delivered tapes in support of the LACIE photointerpretation effort. The capability to produce imagery products from these tapes should be keyed to a process/no process flag contained in the header record for each sample segment. A standard set of data products will exist such that at run

time, a product may be requested and will be generated based on a set of processing default values, which may be manually overridden, and bias and scaling factors contained in the imagery data header information.

2. Two additional capabilities are required to provide system flexibility: tape search, tape edit, and process flag override. To support generation of new imagery based on training segment redefinition, a tape search capability is required for imagery generation based in specifying tape file location or sample segment number. A flexible editing capability is required which will permit the selection of the portion of each scan line to be processed. Additionally, a flag override capability should be provided such that the process/no process flag is ignored and imagery is generated for all segments on the input data tape.

B. Determination of display parameters

1. Color balance factor: In order to maintain consistency in the generation of color images, the capability to generate a percentage of total light exposure intensity (0-100 percent) on a per-color-channel basis (red, blue, and green) is required. The intensity should be adjusted as required based on actual test runs on the film in order to maintain consistent imagery. The correction values used will be indicated in the image header information. (Also required by NASA-DSAD)
2. Enlargement: All products produced on the PFC from either Landsat MSS input tapes or composed image output tapes should be enlarged from the scan lines in the down-track direction should equal approximately $4/3$ times the crosstrack or pixel enlargement.
3. Superimposed grid: Imaging products produced on the PFC require a

superimposed grid produced at every tenth line and at every tenth pixel starting with line 1 and pixel 1. Grid lines should be less than the width of the single repeated scan line or pixel column that is being replaced. Scaling factor and color table section should retain compatibility with current EOD data techniques laboratory capabilities.

4. Bias and scaling factors for both color composite images and black and white images should be applied according to the following equations:

$$Y = A(X + B) + C$$

X = input pixel value

Y = output pixel value

A = scaling factor (from tape header)

B = bias 1 (nominally defaulted to zero)

C = bias 2 (from tape header)

For the generation of color or black and white imagery, the capability is required to input either 256, 16, or 8 intensity levels to the respective channels. The same intensity level should be applied to each channel.

C. Imagery annotation Each image generated on the film

converter for LACIE should be accompanied by the following header information:

1. Job ID
2. System ID
3. Tape Library ID
4. Date tape generated
5. Sensor
6. Orbit
7. Product requested
8. Process skip flag override
9. Sample segment ID, file number
10. Channels requested
11. Bias factors B
12. Bias factors C
13. Scaling factors A
14. Color select
15. Color codes
16. Polarity

17. Repeat of pixel
18. Repeat of scan
19. Sample segment ID

4.1.3.2

Imagery products.- Imagery products will be generated to satisfy the needs of both the photointerpreters and the ADP analysts. Lists of the products to be provided to each group are as follows.

- A. Analyst interpreter imagery products
Landsat MSS imagery products: Imagery products for generation of this subsystem should consist of color composite imagery and black and white imagery generated from Landsat MSS data tapes, and Landsat MSS composed data tapes. Landsat MSS data tapes shall consist of several files of imagery data containing four channels of Landsat data for each 6-nautical-mile by 5-nautical-mile sample segment on the tape. The composed data tapes shall consist of imagery from the sample segment for different acquisition times which has been registered at GSFC.
 1. Color composites, positive will be generated with specific default values for channel and color assignments, will consist only of positive color values, and will be generated for all training segments (Product 1).
 2. Color composites, positive/negative will be generated similar to the previous one; however, positive and negative color assignments shall exist for specific channels (Product 2).
 3. Black and white single-channel images will be required for all sites and for up to four channels per site. The number of channels to process should be variable and processings should be for all training segments (Product 4).

Screening film: Three channel color composite and single channel monochromatic (green) images. Bias and scaling factors will be reduced to TBD percent or the values shown in the header record (Product 7).

- B. ADP analyst imagery products

Derived imagery products. This subsystem will generate imagery products for utilization by the ADP analyst and will be a part of the classification results; however, results imagery of the same scale as the original AI imagery are required for proper interpretation of results.

1. Classification and clustering results tapes generated by the CAMS will be required for input to this subsystem.
2. Color clustering results outputs must be available for all clustering runs from the CAMS. Classification maps will be generated as four-class maps in black and white to the same scale as the original AI imagery.
3. A tape will be generated by the processor and sent to the PFC for display. The PFC will outline training fields on black and white imagery for overlay purposes.

4.1.3.3

PFC processing status reporting.- The PFC will maintain, by film product and sample segment number, a list of imagery products produced. This list will reference the film work request, date of generation, and source (computer) tape. (Also required by NASA-DSAD)

4.1.4

Archives

The purpose of the archives is to store a complete set of data, both active and inactive, so that it will be possible to reconstruct the data base should the need arise. The archive will have two sections, a physical archive located in the LPDL and a tape archive located in the tape library.

Purge control will consist of three functions:

- A. Identifying and removing unnecessary data from the mass data storage (Required by ISRPS, all subsystems; category 2; implemented by NASA-DSAD)
- B. Identifying and releasing unnecessary tapes from the tape library (Required by ISRPS, all subsystems; Category 2; implemented by NASA-DSAD)

- C. Identifying and removing unnecessary documents and film from the active physical library (Required by ISRRS, all subsystems; Category 2; implemented by NASA-S&AD-FSO)

The tape archive will consist of a copy of all GSFC imagery. Partially filled tapes will be merged when feasible to minimize the number of tapes stored. (Required by ISRRS; Category 2; implemented by NASA-DSAD) Purge documents and films will be maintained separately in the LPDL. A complete list of all archived data will be compiled and stored in the LPDL. Duplicate films and documents will be destroyed; duplicate tapes will be returned to service. (Required by ISRRS, all subsystems; Category 2; implemented by NASA-S&AD-FSO.)

- 4.1.5 Tape Duplications
(Required by ISRRS; Category 1; implemented by NASA-DSAD) When copies of existing tapes are required they will be generated in the tape duplications operation of the electronic PDUI. A security system and logging system will be maintained to control access to all data.

- 4.1.6 Electronic Data User Interface
The PDUI will coordinate with the EDUI. All data required by the electronic data storage for processing LACIE data will be processed through the PDUI to the EDUI. The PDUI will insure that all data are in a form acceptable and compatible with the data base.

- 4.1.7 Status and Tracking Functions Physical Data User Interface (PDUI)

- 4.1.7.1 Electronic data. - (Required by ISRRS; Category 1; implemented by NASA-DSAD) Upon receipt of each Landsat data tape from NASA-GSFC the following functions will be performed:
- A. Accession number is assigned.
 - B. Bin in tape library is assigned.
 - C. Tape is copied.
 - D. Original tape contents are entered to the data base.
 - E. For each acquisition entering the C&I data base and affecting an ADD or INSERT status update will generate a "B" card for entry into the EOD status and tracking system.
 - F. The tape copy is sent to the PFC for film generation.

The following information will be maintained:

- A. Tape number
- B. Date received
- C. Copy number
- D. Date copy sent to PFC for imagery generation
- E. Original tape bin number
- F. Copy tape bin number

The status reports will take the form of batch-generated reports. These reports will be generated on a periodic basis using line-printer output. (Required by ISRRS; Category 2; implemented by NASA-DSAD)

For each type of status to be tracked a specific report format must be supplied to ISRRS. Along with each report format a list of parameters to be displayed in the report must also be furnished.

The manner in which reports are to be generated will necessitate the ability to retrieve data from the status and tracking data base on a multiple key parameter basis. (Required by ISRRS; Category 2; implemented by TBD)

The following data levels exists: segment, acreage stratum, yield stratum, zone, region, and country. Derived data from the processing subsystems (CAMS, CAS, and SPE) will be indexed in the manner best suited to their function.

- A. CAMS - by segment
- B. YES - by station, by yield stratum
- C. CAS - by acreage stratum, zone, region, and country
- D. SPE-EA - other subsystem performance by unit processed as shown previously

4.2

ELECTRONIC DATA USER INTERFACE

The storage and retrieval function is the primary one for the ISRRS. All other functions are subsidiary ones intended to assure that storage and retrieval can be accomplished in a timely and secure manner. The storage/retrieval function operates with the data base which contains the electronic data. The ISRRS will have the capability of operating

both a readily accessed mass data storage and a data tape library. The readily accessible mass data portion of the data base will provide the logical organization of the LACIE data so the data input from the various subsystems can be properly stored on a mass storage medium. Conversely, it should provide the logical organization necessary for data to be retrieved for utilization by the subsystems. Separate portions of the data base will require different logical organization. The portion supporting the areal estimation process will necessarily be structured around sample segment-oriented logic. The portion supporting the yield estimation process will likely be structured around geographic location logic. Capabilities for data base expansion, automatic restructuring and automatic definition of new elements are required. (Required by all subsystems; Category 1; implemented by NASA-DSAD)

4.2.1 Status and Tracking Functions: Electronic Data User Interface (EDUI)

Certain updates will be made to the status and tracking sector of the data base via the EDUI. The updates will consist of the following TBD.

4.3 PROCESSOR

4.3.1 Self-performance Tracking

The performance of the ISRRS will be evaluated in terms of the time required to respond to user requests, the accuracy of the response, and the time and accuracy of internal functions. To enable to SPE to track the ISRRS, the following record of data will be maintained:

- A The tape and physical libraries will maintain date records of user requests received and answered. (Required by SPE; Category 2; implemented by NASA-DSAD/NASA-SEAD-FSO)
- B The time required for tape duplications and process film conversion will be logged into the electronic data storage (tape or mass). (Required by ISRRS, Category 2; implemented by NASA-DSAD)

4.4

DATA BASE MANAGER

The Data Base Manager (DBM) will be responsible for implementing the functions described below. These areas represent the minimum required for DBM.

4.4.1

Planning

(Required by ISRRS; Category 1, implemented by NASA-DSAD) The DBM will, in coordination with other concerned organizations participate in and direct all planning, design and implementation of all LACIE data bases.

4.4.2

Data Base Definition

(Required by ISRRS; Category 2; implemented by NASA-DSAD) The DBM will establish an automatic interactive directory which will describe data elements, data element aggregates, data element logical record and file participation, and data element usage.

4.4.3

Data Base Structure

(Required by ISRRS; Category 1; implemented by NASA-DSAD) The DBM will develop a data base structure which will provide efficient and timely data handling and storage based on user data element processing requirements.

4.4.4

Documentation

(Required by ISRRS; Category 1; implemented by NASA-DSAD) The DBM is responsible for the development and maintenance of manuals and handbooks pertinent to data base organization, functions, integrity, and quality assurance. Procedures relating to the use of the data base will be developed and documented as required to satisfy the needs of management, applications systems, and the user. Items developed will include, as a minimum the following:

- A. Data base design specifications
- B. Program specifications
- C. Programmers maintenance manual
- D. Data directory description and usage procedures
- E. Test data base support
- F. Save/recovery/restart procedure
- G. Data base security, safety, and quality assurance procedures

4.4.5

Support Functions

(Required by ISRRS; Category 3; implemented by NASA-DSAD) The DBM will provide support as required in the area of system software.

4.4.6

Data Base Integrity

(Required by ISRRS; Category 1; implemented by NASA-DSAD) The DBM will establish procedures to ensure rapid recovery of all or part of a data base in the event that destruction of part or all of the data base occurs or quality assessment determinations indicate the need to replace current data. Following is a list of capabilities needed to maintain required data standards:

- A. Establish full data base checkpoint tapes as the data bases are built.
- B. Maintain currency of the full data base back-up by checkpointing all data base elements which have been updated. A 1-day interval between update and checkpoint is required.
- C. Maintain a transaction log tape which contains a history of updates. This tape, used in conjunction with the checkpoint tapes described previously, will be used to recover data bases with the minimum of rework.

4.4.7

Automated Libraries

(Required by ISRRS; Category 2; implemented by NASA-DSAD) The DBM will maintain the following software libraries as applicable to support the users:

- A. Program source statement library
- B. Production load module library
- C. Test load module library
- D. JCL procedure library

4.4.8

Data Base Quality Testing

(Required by ISRRS; Category 2; implemented by NASA-DSAD) The DBM will be responsible for quality assurance for the electronic data base.

4.4.9

Electronic Data Base Purge Control

(Required by ISRRS; Category 2; implemented by NASA-DSAD) The DBM will be responsible for purge control. Purge control will consist of

two functions: (1) identifying and removing unnecessary data from the mass data storage and (2) identifying and releasing unnecessary tapes from the tape library.

Unless otherwise specified, all purged data will be forwarded to the archives. Data purged from the mass data storage will be transferred to a tape designated for archive storage. Tapes released from the tape library will be sent to the archive. The directory function will be utilized to verify that archive-bound material does not duplicate anything already stored. Duplicate tapes will be returned to service. The data in the archive storage will be maintained at least through Phase II.

4.5

DATA BASE

The data stored in the ISRRS data base are shown in table 4-I.

4.6

TAPE LIBRARY

(Required by ISRRS; Category 2; implemented by NASA-DSAD) All electronic data which does not need to be readily accessed will be stored on tape in the tape library. The purpose of this is to keep the size of the mass storage to a minimum. Typical of these tapes are the Landsat training segment data not being utilized by the CAMS and the latest checkpoint data. The following electronic data will be stored on tapes: TBD.

The location and contents of each tape in the library will be stored in the content directories located in mass data storage. This data will be duplicated in a printout for the use of the ISRRS librarian.

TABLE 4-I.- ISRRS DATA BASE TABLE

<u>Function</u>	<u>Required by</u>	<u>Generated by</u>	<u>Category</u>
ERTS sample segment data	CAMS	DAPTS	2
Status information	CAM, SPE, YES, IE	DAPTS, CAMS, YES	1
Training field selection data	CAMS	CAMS	1
Training statistics	CAMS	CAMS	1
A priori probabilities	CAMS		1
Thresholds	CAMS		1
Mensuration results	CAS	CAMS	1
Historical meteorological data	YES	YES	2
Historical production Data	CAS	DAPTS	2
Yield coefficients	YES	YES	2
Crop calendar	YES	DAPTS	2
Yield estimates	CAMS, CAS	YES	1
Production forecast results	CAS	CAS	1
Efficiency assessment results	SPE	All	1
Acreage estimation error	CAS	CAMS	1
Tabular reports data	SPE	All	1
Derived statistics	CAMS	CAMS	2
Percent cloud cover	YES	DAPTS	2
Sample segment coordinates	CAMS, CAS	DAPTS	1
Phenological calendars	CAS	DAPTS	3
Data acquisition data base	CAMS	DAPTS	1

SECTION 5.0 ISRRS INPUT

In its capacity as the storage and retrieval subsystem, ISRRS primary function is to relay data from one subsystem, the source, to another subsystem, the destination. In those instances, ISRRS requirements are identical to those of the source and destination subsystem as referenced. In the few instances that ISRRS reformats data, the necessary inputs are specified.

5.1 SOURCE: DAPTS-ERTS
See volume IA, section 6.0.

5.2 SOURCE: DAPTS-FIELD
See volume IB, section 6.0.

5.3 SOURCE: DAPTS-HISTORICAL AGRICULTURAL
See volume IC, section 6.0.

5.4 SOURCE: CAMS
See volume II, section 6.0.

Destination: ISRRS

- A. ADP imagery tapes. Imagery products resulting from CAMS classification activities will be stored on tape in a format compatible with the PFC. The imagery products will be those defined in section 6.1.6i. (Required by ISRRS; Category 1; implemented by CAMS)
- B. CAMS/CAS interface tapes. CAMS shall output all classification results to tape. These tapes will be provided daily by NASA-DSAD to NASA-S&AD-FSO where the results will be reformatted and merged into one tape for CAS. (Required by ISRRS; Category 1; implemented by CAMS, NASA-DSAD, NASA-S&AD-FSO)

- 5.5 SOURCE: Yes
See Volume III, section 6.0.
- 5.6 SOURCE: CAS
See volume IV, section 6.0.
- 5.7 SOURCE: SPE-EA
See volume VIA, section 6.0.
- 5.8 SOURCE: IE
See volume VII, section 6.0.
- 5.9 SOURCE: RESEARCH
See volume VIII, section 6.0.
- 5.10 SOURCE: TEST AND EVALUATION
See volume IX, section 6.0.

SECTION 6.0 ISRRS OUTPUTS

In its capacity as the storage and retrieval subsystem, ISRRS primary function is to relay data from one subsystem, the source, to another subsystem, the destination. In those instances, ISRRS requirements are identical to those of the source and destination subsystems as referenced. In the few instances that ISRRS reformats data, the output products are specified.

6.1 DESTINATION: DAPTS-ERTS
 See volume IA, section 5.0.

6.2 DESTINATION: DAPTS-FIELD
 See volume IB, section 5.0.

6.3 DESTINATION: DAPTS-HISTORICAL AGRICULTURAL
 See volume IC, section 5.0.

6.4 DESTINATION: CAMS
 See volume II, section 5.0.

Source: ISRRS

- A. Landsat MSS tape products
Landsat MSS tape products shall consist of color composite and black and white imagery generated from Landsat segment data. This imagery shall be produced, at the nearest practicable scale, to 1:125,000, so that constant spacing between pixels occurs in the crosstrack direction and constant spacing between scan lines occurs in the along track direction.

Gain and bias values for all Landsat-B MSS segments are supplied in the header record for all tapes received from GSFC on a per channel basis. These values shall be used

and shall be stored for future use as follows.

All products shall have a superimposed grid at every tenth line and pixel starting at line 1 and pixel 1. The grid shall not obscure more than one-half the area of any pixel.

1. Screening film: (Product number 7)
Screening film shall be produced for every acquisition of every segment. It shall be a moderate gain simulated color IR product using MSS bands 4, 5, and 7 and a monochrome moderate gain product for band 6.

MSS band 4 shall be assigned the color blue in the color composite; MSS band 5 shall be assigned the color green; MSS band 7 shall be assigned the color red; and MSS band 6 shall be used to create a monochrome image.

In each case, the overall bias, C, used for a band shall be taken from the tape header and multiplied by a TBD constant. Bias B shall be zero. The gain, A, shall be the value taken from the tape header multiplied by the previously mentioned TBD constant.

2. Color composite positive: (Product number 1) This product shall be produced for the first acquisition in each biological phase of all currently designated training segments. It is a high gain simulated color IR product using Landsat MSS bands 4, 5, and 7.

The color blue shall be assigned to MSS band 4. The bias B shall be zero. The bias C shall be taken from the GSFC header record. The gain shall be taken from the GSFC header record. The color green shall be assigned to MSS band 5. Gains and biases are as previously mentioned.

3. Color composite positive/negative: (Product number 2) This product shall be produced for the same acquisitions as the color composite positive.

The color red shall be assigned to MSS band 5. The bias B shall be zero. Bias C shall be taken from the GSFC header. Gain shall be taken from the GSFC header.

The color blue shall be assigned to MSS band 6. The bias B shall be zero. Bias C shall be the bias value in the GSFC header. Gain shall be the gain value in the GSFC header.

The color green shall be assigned to MSS band 7. The gain and bias shall be as mentioned in the previously paragraph.

4. Black and white images: (Product number 4) A black and white image shall be produced for each band of the first acquisition in each biological phase of each currently designated training segment. These will be high gain images.

The biases B shall be zero. The biases C shall be obtained from the GSFC header. The gains shall be obtained from the GSFC header.

5. Image header: Each LACIE Landsat MSS image should be accompanied by the following header information on the film:

- a. Job ID
- b. System ID
- c. Tape library
- d. Date tape generated
- e. Sensor
- f. Orbit
- g. Product requested
- h. Sample segment ID, File number
- i. Channels requested
- j. Bias factors B
- k. Scaling factors A
- l. Color codes
- m. Polarity
- n. Repeat of pixel
- o. Repeat of scan
- p. PFC Color balance factors
- q. Date of sensor data acquisition
- r. Landsat scene

- s. PFC run date
- t. PFC tape I.D.
- u. Output mode
- v. Number of pixel hits

B. ADP imagery

Imagery products shall consist of transparencies at the approximate scale of 1:125,000. The exact scale shall be nominally identical to that of Landsat MSS tape products. ADP image outputs shall be overlaid with a line and pixel ground identical to that used for the initial imagery.

1. Field verification overlay. (Product number 12) This shall be an image indicating the boundaries and identities of all fields in a given segment. It shall be produced for a segment following any occasion on which the fields data base for that segment is updated.
2. Cluster map. (Product number 9) The cluster map shall indicate the (chained) subclasses found within each class. It is permissible to combine the results of more than one clustering run on a single map. The maximum number of clusters per cluster run will be 20. Cluster symbols may be repeated in different runs, but not within a run. The boundaries and identities of all field(s) shall be indicated by a technique which does not obscure any pixels. It is permissible to utilize multiple sheets to accomplish this. This cluster map shall be produced for all clustering runs. This map should contain an identifying run number.
3. Classification map. (Product number 8) The classification map shall indicate wheat versus harvested wheat versus other versus unidentifiable versus thresholded. The boundaries and identities of all fields(s) shall be indicated by a technique which does not obscure any pixels. It is permissible to utilize multiple sheets to accomplish this. The classification

map shall be produced for all classification jobs. This map should contain an identifying run number.

- C. Optional Landsat imagery
System default values can be utilized to generate any combination of color composites or black and white images not available as standard products. (Required by NASA-SEAD-RT&E; Category 1; implemented by NASA-DSAD)

6.5

DESTINATION: YES
See volume III, section 5.0.

6.6

DESTINATION: CAS
See volume IV, section 5.0.

Source: ISRRS

- A. CAMS/CAS interface tape. The ISRRS shall supply to CAS sample segment classification from the CAMS/CAS interface results tape generated by CAMS at 1-day intervals. ISRRS shall also merge the daily tapes into one master tape for delivery to CAS. ISRRS will supply library storage for the tapes. (Required by CAS; Category 1; implemented by NASA-FSO)

- B. Sample Segment Status Matrix.
A sample segment status report (in tabular form) is required daily. The status of all sample segments are as follows:
1. Date Landsat data acquired
 2. Wheat biological stage
 3. Status: acquired - not classified, acquired - classified suitable acquired - classified marginal, and acquired - classified unsuitable

The capability will be supplied to sort segment status by country, region, zone, and by classification evaluation (suitable, marginal, and unsuitable) (Required by CAS; Category 2; implemented by ISRRS)

6.7

DESTINATION: SPE-EA
See volume VIA, section 5.0.

6.8

DESTINATION: IE
See volume VII, section 5.0.

6.9

DESTINATION: RESEARCH
See volume VIII, section 5.0.

6.10

DESTINATION: TEST AND EVALUATION
See volume IX, section 5.0.

SECTION 7.0
INTERFACE REQUIREMENTS (DOCUMENTS)

Each implementing organization shall comply with the interface requirements specified in the following documents.

- A. The following interface control document is requisite for establishing the volume and formats for agency inputs to the ISRRS data base. The acreage estimate portion of LACIE requires the following document:
GSFC/JSC interface control document for the large area crop inventory project initial system, dated 17 April 1974.
- B. The addition of yield and production estimates to the system requires two additional documents:
 - 1. TBD (NOAA/JSC ICD)
 - 2. TBD (USDA/JSC ICD)

SECTION 8.0 OPERATIONAL REQUIREMENTS AFFECTING SUBSYSTEM DESIGN

A number of the LACIE operational requirements will influence the design of the ISRRS. These requirements are explored in the following sections.

8.1 THROUGHPUT REQUIREMENTS

8.1.1 Electronic Data (Required by CAMS/ Category 1; implemented by NASA-DSAD)

8.1.1.1 Production film converter (PFC).- The number of Landsat data sample segments which must be displayed requires an amount of PFC time which is marginally met by the projected available display time. Additional imagery generation capability may be required to support the operational LACIE system. A number of factors must be finalized before a definitive estimate of the total amount of required imagery generation time can be estimated.

8.2 RESPONSE TIME REQUIREMENTS

8.2.1 Electronic Data

8.2.1.1 Data base requirements.- (Required by ISRRS; Category 2; implemented by TBD) The size of the LACIE status and tracking data base which must be active is extremely large. Attendant with the size of the data base is the fact that data will be required to be retrieved using multiple keys. These two factors may have a significant impact on the response time of the status and tracking system.

8.2.1.2 Multi-temporal classification.- (Required by CAMS; Category 1; implemented by NASA-DSAD.) Multi-temporal classification required that imagery from the same sample segment, for multiple acquisitions be collected into "composed images" for classification. It may be necessary to output earlier acquisitions for a given sample segment on computer tape since the mass storage capability of the LACIE

processor may not be adequate to store all the required sample segment data at any one time. The retrieval of tapes from the tape library and re-insertion into the data base poses a potential response time impact to multi-temporal classification.

8.2.2

Physical Data

(Required by ISRRS; Category 2; implemented by NASA-S&AD-FSO)

The response of the library to requests for physical data will be related to the number of items contained within the library. This becomes particularly significant when tracking the status of each item on file. Since the number of separate pieces of imagery will be in excess of 1×10^5 items over the duration of LACIE, a computer-aided logging and tracking system is viewed as being potentially helpful in achieving satisfactory response times to physical data user requests.

8.3

RELIABILITY REQUIREMENTS

8.3.1

Electronic Data

(Required by ISRRS; Category 1; implemented by NASA-DSAD)

The LACIE data base shall be designed such that the loss of any one disk storage unit is not catastrophic. The data base should be segmented so that in the event of the failure of any disk storage unit the information stored thereon can be reconstructed from checkpoint tapes which are to be generated daily, and from the transaction log. Reconstruction of up to a day's loss shall be accomplished in TBD minutes. At this time no figures are available on MTBF and MTTR associated with the LACIE processing system.

8.4

SECURITY REQUIREMENTS

8.4.1

Physical Data Security

(Required by CAS, ISRRS; Category 1; implemented by NASA-S&AD-FSO)

Checks should be made to assure the physical security of the work areas, data products, logistics, disposition of data products, and

storage/archiving, related to CAS output products.

- 8.4.1.1 Controlled access. - An evaluation should be made of all processes and facilities to determine those areas that should be restricted. An operational procedure for the admission of all personnel to these areas should be developed to assure maintenance of the proper level of security.
- 8.4.1.2 Data receipt. - A procedure for receiving data must be developed that will assure that proper security measures are in effect. At a minimum the following points should be checked.
- A. Actual receipt
 - B. Verification of contents
 - C. Logging of data
 - D. Notification to the system of receipt
 - E. Temporary storage
 - F. Distribution
- 8.4.1.3 Surveillance of data. - A procedure for surveillance of all data and actual on-floor operations should be developed with a system of spot checks implemented to assure accountability and traceability.
- 8.4.1.4 Release of data. - A division of data products should be made to allow for the wide dissemination of unclassified portions of the final data products and controlled release of sensitive data. Checks must be developed to assure the routing of data into the proper channel.
- 8.4.1.4.1 Authorization. - The proper authorization for release of data must be verified. The distribution of the data being released must also be verified.
- 8.4.1.4.2 Accountability. - Assurance should be made that the logs reflect the disposition of the data and the authorization for release.
- 8.4.1.4.3 Transmittal of data products. - Checks should be made upon the transmittal of all data products to assure that the security system is intact.

- 8.4.1.5 Shipping.- The shipment of LACIE data should be done in containers that are designed to preserve the quality of the data.
- 8.4.1.6 Storage/archiving of data.- The mixed medium of the LACIE products coupled with the current and historical nature of the data makes the storage and archiving of data significant from a security viewpoint. Procedures must be implemented to assure that proper security is maintained.
- 8.4.1.6.1 Controlled access.- Access to storage areas should be in accordance with section 8.4.2.1.
- 8.4.1.6.2 Surveillance.- The area should lend itself to surveillance as specified in section 8.4.2.3.
- 8.4.1.6.3 Environment.- Controls should be put upon the environment of the storage/archive areas to assure that the data will not be affected by temperature, humidity, lighting, electromagnetic radiations, vibration, etc.
- 8.4.1.6.4 Data Handling.- A procedure must be developed for the classification, cataloging, and indexing of data that meets the security and quality specifications. It should also facilitate all authorized retrieval actions and should provide traceability and accountability. The purging or downgrading of certain data to maximize the available storage space must be verified prior to removal of any data.
- 8.5 DELIVERY REQUIREMENTS
(Required by ISRRS; Category 1; implemented by NASA-DSAD)
- 8.5.1 PFC Film Products from GSFC Tape
All film products will be sheathed immediately after processing so that the film emulsion and base can be protected from scratches and other damage. The film should then be cut to include each sample segment imagery and its associated film header. All cut imagery for a given sample segment will be placed in an envelope or suitable container for delivery. The outside of the container will be clearly marked with

the sample segment number and a list of products enclosed.

8.5.2 PFC Film Products from Data Processing Requests (DPR's)

Same requirements as defined in paragraph 8.5.1 except that imagery will be packaged and delivered by DPR number rather than segment number. A full list of enclosed imagery will be indicated on the outside of the container.

8.6 QUALITY CONTROL REQUIREMENTS

8.6.1 ISRRS Inputs

The inputs to the ISRRS will consist of data records on tape, results of computations of other subsystems, requests for data and data records, GSFC data base status reports, JSC daily reports of received data, Photointerpreter training, test and other field definitions from the Landsat imagery, etc., meteorological data and requests from the various subsystems for retrieval and computation of data. These and other inputs as received across organizational and subsystem interfaces should be checked.

8.6.1.1 Sample segment data.- Periodically verify that all sample segment data that is received each day is placed in the data base. (Required by ISRRS; Category 1; implemented by ISRRS)

8.6.1.2 Physical storage.- All items received for physical storage by the ISRRS should be checked for proper identification, labeling, and for completeness. (Required by ISRRS; Category 1; implemented by NASA-S&AD-FSO)

8.6.2 Data Transformations
(Required by ISRRS; Category 1; implemented by NASA/DSAD)

8.6.2.1 Field data base.- All updates to the field data base must be done under strict quality control as it involves total replacement of data. All inputs must be checked for correctness, and the revised record(s) should be checked to insure

insertion of the proper data. (Required by ISRRS; Category 1; implemented by CAMS)

8.6.2.2 Storage and retrieval safeguards.- Incorporate information storage and retrieval safeguards into all routines which access the data base to insure only "real" data is placed into the data base and that the data base is not altered during information retrieval. (Required by ISRRS, Category 1; implemented by NASA-DSAD)

8.6.2.3 Data base integrity.- Provide for periodic file verification routines to be run to insure the integrity of the data base. This is particularly critical subsequent to an error recovery or equipment malfunction to insure that "garbage" has not crept into the data base. (Required by ISRRS; Category 1; implemented by NASA-DSAD)

8.6.2.4 Composed image tape.- The process of composing Landsat data from the same sample segment onto tape to form multichannel (up to 64) temporal data sets must be checked to insure the creation of the proper data records on the tape.

The header record should be checked to see if the number of channels are updated, that the tape generation date is updated, and definition made of the last image transmitted from GSFC. (Required by ISRRS; Category 1; implemented by NASA-DSAD.)

8.6.3 ISRRS Outputs
(Required by ISRRS; Category 1; implemented by NASA-DSAD, NASA-SEAD-PSO)
Outputs from the ISRRS will be data and data records received from GSFC and NOAA, parameters required by other subsystems either direct from the data base or as the result of computations, reports and data purged from existing computer and manual files.

8.6.3.1 Purging computer data base.- The purging of data from the computer data base and from physical files must be done under strict

controls. The request to purge data must be checked to insure proper authorization.

8.6.3.2 Tape outputs.- Output computer tape for input to another subsystem, or tape containing checkpoint data should immediately after generation be read on a tape drive different from the one used to write the tape.

8.6.4 Production Film Converter
(Required by ISRRS; Category 1; implemented by NASA-DSAD)

8.6.4.1 Line test.- The Production Film Converter (PFC) operation should be prefaced with a standardized line test prior to the commencement of daily operations. This PFC line test would be similar to that of the benchmark tape for ADP operations. The input would contain data which would exercise the PFC and the Photographic Technology Laboratory (PTL); the output imagery would be compared with a standard and would exhibit the same characteristics if the PFC and the PTL were operating properly. The operational variables which can be practically checked need to be identified and the limits of their variability quantified as they affect the photointerpreter's task. The line test should insure the compatibility of the PFC and the PTL; it must insure that the PFC/PTL system is capable of consistent repeatable results. Set up a schedule for running the line test in a normal mode and identify the situations which will require a special run of the line test, i.e., following emergency/corrective maintenance, an engineering activity, preventive maintenance, or an abnormal power-down.

The line test should be conducted on at least a weekly basis. Included should be a 3-color registration/fidelity test, the results of which are to be kept on file in the event that discrepancies occur between temporarily separated film products.

8.6.4.2

Film stock. - Once the variables which affect the AI's task are quantified, they should be correlated to changes in the chemical characteristics of the film stock. Different batches and cuts of film have different chemical characteristics which would affect the output of the PFC/PTL system if corresponding changes are not made. If it is determined that these emulsion changes do have an effect upon the AI's task, then quality assurance procedures must be developed to insure consistency of results from the PFC/PTL. The incoming raw film stock should be checked to insure that it meets JSC specifications. Tests should be run for each new batch and cut and the resultant crossover specifications input to the PFC and PTL to compensate for variations.

Insure that the product imagery meets the quality requirements for such things as density, color balance, image size and proportions, proper annotation, proper registration, and uniformity throughout the image as well as for general cosmetics, i.e., scratches, pin-holes, emulsion tears, dirt, dust, etc.

8.6.4.3

Output completeness. - Verify that all sample segments keyed in the header record for processing by the PFC were actually processed and the required output delivered.

8.6.5

Logistics/Data Handling
(Required by ISRRS; Category 1; implemented by NASA-SEAD-FSO)

8.6.5.1

Physical storage. - The physical storage of data records including computer tape, film, listings, reports, and microfiche requires quality control procedures to insure proper accounting and control of the records. Requests to release or destroy data records should be double-checked for proper authorization and the records themselves checked to insure that the correct ones are being processed.

8.6.5.2 Data transfer.- The transfer of data will have adequate control information with appropriate logs maintained at each arrival/departure point of the data.

8.6.5.3 Audits of shipments.- A constant auditing of shipments of data from GSFC is required to insure arrival of the data in a timely manner and to promptly identify lost shipments and initiate tracing action.

8.7 OTHER OPERATIONAL REQUIREMENTS

8.7.1 Data Base Integrity
(Required by ISRRS; Category 1; implemented by NASA-DSAD)
The LACIE system required that large amounts of data be available for the development of program constants and for the analysis of the global wheat production. The data base must be constructed in such a fashion as to provide systems confidence. It must be open-ended to provide maintainability, flexibility, and expandability, the factors which constitute systems integrity.

8.7.1.1 Access and security.- The data base must have access controls levied upon it to faithfully reproduce its contents. Unauthorized entry for modification purposes must be precluded. The data base will be accessed for data analysis purposes in various modes and with various applications programs. It must be determined whether random or direct access is the best mode to assure the integrity of the data base. Security measures must be assured to preserve the integrity of the data base.

8.7.1.1.1 Sizing.- Procedures must be implemented which will assure a proper correlation between data base requirements and its sizing. The finite file limits and sizes must be continually monitored to insure the limit has not been reached and thus preclude and loss of data.

8.7.1.1.2 Updating.- The various aspects of updating the data base discussed in previous sections must be implemented to assure data base integrity.

- 8.7.1.2 Purging.-- The purging of unwanted or unneeded data from the data base should be done under strict control; many aspects have been presented in previous sections. Subsequent to any purge of data, a check must be made on the remaining data base to assure its integrity.
- 8.7.1.2.1 Indexing.-- The purge procedure should have a check system to insure that the indexing module is directing the system to the proper locations.
- 8.7.1.2.2 Archiving.-- All data base purge operations designed to archive portions of the data base onto magnetic tape should be verified. The physical tape should meet all quality requirements; the tape should be read and the copied data compared with the original to assure a one-to-one correspondence.

SECTION 9.0
ISRRS VERIFICATION REQUIREMENTS

Each organization designated with implementation responsibility shall prepare a LACIE verification plan, including a complete definition of the verification functions proposed for verification of the portion of LACIE for which they are responsible. Each organization shall submit their plan for approval to the LACIE Level III change board within 90 days after the requirements documents are baselined. As a minimum, the verification plan shall include the following related to the DAPTS subsystem.

- 9.1 VERIFICATION DOCUMENTATION
(Required by ISRRS; Category 1; implemented by NASA-DSAD)
- 9.1.1 ISRRS Test Plan
A test plan will be developed by the implementer which defines the tools, procedures, and responsibilities for conducting all levels of ISRRS tests. Within the test plan will be sections related to the different test levels.
 - 9.1.1.1 Unit test.- Within this section, testing will be defined for the lowest level program modules within the ISRRS prior to combination with other units. Unit test objectives, responsibilities, procedures, and tools will be defined.
 - 9.1.1.2 Integration test.- Within this section, testing will be defined for combined tested software units. Combined groups of tested units will be successively tested until the entire ISRRS software package is tested as an integrated unit. Objectives responsibilities, procedures, and integration test tools will be defined.
 - 9.1.1.3 Higher order tests.- System and acceptance tests must be conducted on a LACIE-wide level and are not the responsibility of ISRRS.
- 9.1.2 Integration Test Specification

For the integration test, a specification should be developed which describes the test philosophy, the general objectives, general procedures, and the success criteria. A separate section of the test specification should define the functional software areas versus the test case numbers designed to test them. The integration test specification will be developed by the implementer.

9.1.3

Test Case

For each functional software area a unique test case should be designed for integration testing. Each test case should contain test objectives, assumptions, references, and success criteria. Each test case should contain the simulated input data, live input data, and predicted output data used in the test.

A section of the test case should be devoted to a test script which details procedures for conducting the test step-by-step. Corresponding to each step in the procedure, allowance should be made for comments.

A checklist should be included as an integral part of the test case. As each step in the procedure is completed it will be checked off this list. Within the test script, these questions should be answered:

- A. What action is to be taken?
- B. Who is to perform the action?
- C. When is the action to be performed?
- D. What should the test conductor look for?
- E. What information should be recorded?

9.1.4

Integration Test Report

Problems encountered during the integration testing should be identified in an integration test report. Each problem should be identified by the number of the test case being conducted when the problem occurs. The program modules in which each problem occurs should be identified if possible. Each problem should be described and supporting data documented. Recommendations of possible problem solutions should be made in the integration test report.

9.2

DESTINATION OF TFST REPORTS

Copies of unit test procedures will be supplied to EOD, the implementer. Integration test reports related to ISRRS testing will be supplied to EOD within 2 weeks of the completion of integration testing.

9.3

HIGHER ORDER ISRRS TEST RESULTS

The portion of the acceptance test plan applicable to ISRRS must define the acceptance criteria for the performance of the ISRRS. These criteria should be mutually agreed upon by EOD and the implementer and should contain quantitative criteria such as:

"The ISRRS is capable of servicing
'A' terminals with a maximum response
time of 'B' seconds."

or

"The ISRRS data base should be
capable of containing 'C' sample
segments at any one time."

EOD personnel will participate in acceptance testing of the ISRRS and will levy acceptance test reports against the system which will require resolution prior to final acceptance of the processing system. The system may, however, be conditionally accepted if a commitment for resolution of the problems documented in the acceptance test reports within a TBD time period is obtained.

9.4

ISRRS MODIFICATION VERIFICATION

Any modification of the ISRRS will be tested in the same manner as the original system. In addition to the normal required testing, system modification will require regression testing to ensure that modification of the unit in question does not adversely affect other software modules.

Prior to operating the modified ISRRS module a benchmark test is to be performed using a set of live data which yield known results. A Benchmark Test Report is to be prepared and

submitted to EOD prior to the modified module becoming operational.

9.5

SUBJECTIVE EVALUATION OF ISRRS OUTPUTS

In some cases, quantitative evaluation of ISRRS outputs is not possible. One example is the quality of the PFC imagery. In these instances, a joint evaluation of the output product will be made by EOD and implementer representative using standard evaluation criteria.

SECTION 10.0 RESEARCH REQUIREMENTS

Research requirements will be normally satisfied by the ISRRS applications system. In most instances, the minor exceptions have been included in sections 4, 5, and 6. Typical of these is the data involved in the Landsat Intensive Study Sites. These sites are unique in that they are utilized in the research effort but are stored in and processed by the operational elements of the ISRRS. In addition, the ISRRS requires the following research to be conducted.

SECTION 11.0
TEST AND EVALUATION REQUIREMENTS

The ISRRS requires the following test and evaluation to be conducted: None.

RETHINK FACE BLANKS - DO NOT